Loss Prevention Standards – Cross Classes

Deterioration of Stock

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This document provides guidance on mitigation measures to reduce the potential risk of damage or loss of stored goods that are normally housed in controlled environments.

AVIVA

Deterioration of Stock

Introduction

Deterioration of Stock is an Engineering insurance policy. It covers the damage to or loss of stored goods, that are normally housed in a controlled environment, e.g. temperature, humidity or air quality controlled. The policy normally covers stored commodities following:

- A rise or fall in the temperature, outside of quality thresholds.
    - Some stored commodities can be damaged by a fall in temperature, just as easily as a rise in temperature.
- Contamination by a fluid where the root cause is linked to the controlled environment equipment e.g. equipment failure and refrigerant gas (ammonia) release.
- Any cause not otherwise excluded.

As this is an Engineering cover, the root cause of the incident is sudden and unforeseen and relates primarily to the equipment/arrangements associated with maintaining the controlled environment.

Fire is not normally an insured peril and as such the construction of the temperature-controlled store is not normally of great importance for this Insurance coverage.

In Loss Prevention and Insurance terms, key variables include the:

- Size of the store.
- Type of commodities stored and their physical arrangements.
- Nature, age and arrangements of the refrigeration/temperature controlling equipment.
- Control and alarm provision of the important controlled environment variables.
- Resilience of the power supplies.
- Emergency response and contingency plans.

Note: Loss of Revenue or Profit arising from the loss of the goods will usually need to be insured separately.

This Loss Prevention Standard focuses on the Engineering related advice for Deterioration of Stock and not the wider Property or Liability Loss Prevention guidance.

In all cases Aviva's general Property risk management advice is:

- All construction should be inherently non-combustible, with an appropriate fire compartmentation strategy.
- Based on the values exposed, automatic fire suppression in the form of automatic sprinklers should be considered.
    - At a minimum automatic fire detection should be provided throughout, alarming to a constantly attended location with an appropriate level of response.
- Appropriate risk assessments and management controls should be in place, especially for ignition source management e.g. electric systems and devices, hot work etc. Fire Risk or Dangerous or Explosive Atmosphere Risk Assessments.

Definitions

Ambient Storage: Storage that normally requires no refrigeration or chilling equipment. It is normally maintained at 'ambient' or 'atmospheric' temperature and humidity. In some exceptional circumstances, such as prolonged hot spells, refrigeration may be used to maintain a temperature that is the normal 'ambient', or with prolonged very cold temperatures where heating may be used to raise the temperature.

Cold Storage: Storage that normally requires refrigeration or chilling equipment to maintain and control the storage chamber within a set temperature range, normally lower than the ambient conditions.

Store or Chamber: The physical structure of the storage chamber in which goods are stored. This can be as small as a domestic refrigerator/freezer up to large scale temperature-controlled warehouses.

Refrigerant: A refrigerant is a working fluid used in the refrigeration cycle where, in most cases, they undergo a repeated phase transition from a liquid to a gas and back again. Refrigerants are heavily regulated due to their toxicity, flammability and the contribution of CFC and HCFC refrigerants to ozone depletion and that of HFC refrigerants to climate change. Some common refrigerants are listed below:

Refrigerant Code	Formula	Name
R-290	C3H8	Propane
R-600a	HC(CH3)3	Isobutane
R-717	NH3	Ammonia
R-1234yf HFO-1234yf	C3H2F4	2,3,3,3 Tetrafluoropropene
R-744	CO2	Carbon dioxide
R-32 HFC-32	CH2F2	Difluoromethane
R-134a HFC-134a	CH2FCF3	1,1,1,2-Tetrafluoroethane
R-410a		50% R-32 / 50% R-125 (pentafluoroethane) (seen as a replacement for R-22)
R-152a HFC-152a	CH3CHF2	Difluoroethane
R-407c		Mixture of difluoromethane (R-32) and pentafluoroethane (R-125) and 1,1,1,2-tetrafluoroethane (R-134a)
R-454B		Difluoromethane and 2,3,3,3-Tetrafluoropropene
R-513A		HFO/HFC blend (56% R-1234yf/44%R-134a)
R-514a		HFO-1336mzz-Z/trans-1,2- dichloroethylene (t-DCE)

Refrigerating Plant: The equipment and machinery used to control the temperature (or atmospheric environment) in the cold chamber. The key components are the refrigerant gas/liquid itself, evaporators, heat exchangers, compressors, fans, the piping network etc.

Size of the Store & Commodities Stored
In understanding the exposure caused in any given store, the size of the storage area should be known:

- ✓ Length
- ✓ Width and
- ✓ Height

The storage may be in small refrigerators or freezers, up to purpose built cold stores, owned or operated by the insured or in a rented storage space.

In addition, the commodities being stored should be fully understood and recorded, with the upper and lower range of the permitted storage conditions being fully risk assessed aligned with appropriate Quality Control measures. It is important to understand when a commodity goes out of specification and the implications to the product of this divergence. This is fundamental to ensuring the 'risk' is appropriately arranged to minimise the exposure and this will directly impact any contingency plans. E.g. frozen commodities in a freezer need to be below -18°C or an ambient storage chamber where the goods should not be over 18°C and not below 4°C. What are the implications to the stored products outside of these criteria?

Refrigeration Equipment
When maintaining the environment within the storage chamber the arrangements and control of this equipment are critical. This should be fully risk assessed.

From a basic fire prevention and good risk management perspective, the room/area housing the refrigeration (environment creating) equipment should:

- Not be located directly onto the roof/ceiling of the chamber.
- Be in a separate fire compartment to other equipment. Ideally this should have at least a 1-hour fire resistance rating.
- Be appropriately ventilated, so that when the equipment is working its hardest all heat generated by motors, evaporators etc. can be dissipated.
    - Operating equipment at elevated temperatures can cause underperformance, premature failure and fire.
- Be maintained totally free from combustible materials and sterile.
    - If small amounts of combustible materials are required to be in the area e.g. manuals etc. then these should be housed in normally closed and secured metal cabinets.
    - It is not good practice to have combustible materials around important utilities. In a fire event these can easily exacerbate any situation and cause a greater than expected incident.
    - Oil leaks should be cleared away immediately with non-combustible non-wicking materials and the source of the leak repaired.

The refrigeration equipment itself:

- Is the age of the refrigeration equipment known?
- Have any of the components or major equipment items been refurbished or replaced?
    - If so when and why?
    - Is this recorded?
- Are any incidents or failures reviewed to ensure there are not common causes and all lessons are learnt?
    - Do any such incidents modify inspection, testing and maintenance activities?

Is the system designed:

- To meet the maximum thermal load, even during a prolonged hot summer period?
- With resilience and redundancy built into the system?
- With duty and back up equipment for critical items? e.g. N+1 or N+2. So if 1 item of equipment fails there is a reliable means of maintaining the required environment.
    - If back up equipment is provided:
        - Is this located in a separate fire compartment? So a single fire event cannot impact all equipment.
        - Does it have a separate piping network?
        - Is it fed from different electrical switches?
        - How resilient is the overall arrangement?

Another thing to consider is the action of any defrosting cycles and the implications of this on the refrigeration equipment:

- Are ice crystals formed in this cycle and what is the effect of these on the equipment?
- Are icicles forming and then breaking off?
    - What could be the impact damage or can these be entrained into other areas of the equipment?
- Is there increased corrosion or rust caused by the defrost cycle?
    - This can lead to premature failure.

Temperature Variation

For any storage arrangement and stored commodity, the upper and lower limits of the environmental parameters should be fully understood. This is normally temperature; but can also include humidity and even air quality in some instances.

The rise or fall in temperature can be caused by the following:

- The malfunction, breakdown or damage to the refrigeration equipment.
- Poorly designed refrigeration system including air distribution/recirculation in the chamber.
- Prolonged periods of high or low ambient temperatures.
- Poor temperature control and profiling.
- Failure of the electricity supply.
- Storage configurations that prevent appropriate air movement and create ‘stagnant’ pockets.
- Operator error.
- Openings into the cold store not closed.
- Damage to the cold store itself.

Temperature Controls and Alarms

When considering a controlled storage environment, the key is to establish what are the acceptable storage parameters. It is essential that temperatures are maintained within the desired range of the stored products contained therein. Once understood, the control, alarm and interlock philosophy that supports this should help address and mitigate the expected exposure.

What should be monitored?

In trying to understand what variables or equipment should be monitored, risk assessments should be completed to establish what are deemed important to the continued operation of the chamber within the tolerable limits. This should also be based on the level of emergency response.

Chamber temperature

- Consider where the monitoring devices should be located within the chamber. There will be temperature gradient across the storage.
    - Where are the air inlets or the air recirculation fans located? The temperature at these discharge points will be the coldest in the chamber.
- Multiple monitoring points should be considered at different levels? Cold air falls, hot air rises.
- Consider stagnant air pockets in areas of the store where the air is not/cannot be moved. This air temperature will be different to a homogeneous air mixture.
- Consider storage configurations, stock levels and arrangements that limit air movement, prevent circulation or exacerbate temperature variations – how is this measured?
    - Is the atmosphere within the chamber a homogeneous mixture?
- Consider 'low' and 'high' temperature (and humidity if important) alerts and alarms at slight deviations to the normal…
    - And then have 'low low' and 'high high' alarms, as the chamber approaches more critical deviations and approach the 'off specification' upper and lower limits.
- Have integral thermometer(s) to provide an immediate visual temperature confirmation for employees present on the ground.
    - In many cases a visible digital display at doorways, within the chamber or outside of the chamber can provide immediate confirmation.
    - However, this is dependent solely on the location of the detection device and may not be reflective of the entire storage configuration.

Refrigeration equipment

- Is the equipment operating – on/off?
- What is the refrigerant cycle pressure?
- What are the refrigerant cycle inlet and outlet temperatures?

It is worth noting that for an Engineering Policy covering Deterioration of Stock 'fire' in the storage chamber, is not normally a peril that is insured. This cover should be provided by a standard Property insurance policy.

For completeness and good loss prevention practice, based on the exposure to fire and appropriate risk assessments, the following should be provided:

- Appropriate interlocks (cause and effects) to key process alarms.
- Automatic fire detection in all areas interlocked to shut down the ventilation into the chamber.

Chamber Doorways
In addition, to the chamber controls and telemetry, the doorways into any chamber can also compromise the environmental conditions within, therefore all chamber doors should be:

- Automatically closing; or on a timer to automatically close.
- Alarmed if not appropriately closed/latched.
- Kept locked/secure when not in use by employees.

Where should these parameters be monitored to?
All control systems, alerts and alarms etc. that are deemed important to the operation of the chamber should be monitored. This could include the following based on the associated risk assessment and the emergency response available:

- A constantly attended location.
- A Building Management System that provides continual temperature monitoring and recording, that also provides automatic voice, text or email alerts to key site officials including emergency response team members, site security, key holders etc.
- A local sounder and beacon.

If there is no automatic temperature logging, a normal *Policy Condition* applied to the policy is to ensure the temperature within the chamber is manually checked and formally recorded at least once every 24 hours. The record should log the:

- Date
- Time
- Temperature

This must be completed at a frequency of *at least every 24 hours*.

Note: Where storage is in a public or 3rd party operated cold store, the service provider should complete this manual task and keep appropriate records.

Refrigerant
If there is a release of the refrigerant, aside from the associated loss of cooling and the associated exposure to the commodity stored from a rising temperature, the loss of containment of the refrigerant can pose other hazards such as: fire, explosion, asphyxiation, corrosion, toxicity, contamination and damage to the environment.

The Material Safety Data Sheet of the refrigerant should be reviewed; the process conditions of the refrigerant and refrigeration cycle understood and the arrangements of the refrigeration equipment risk assessed, to ensure all exposures are understood and mitigated to As Low As Reasonably Possible. All of these additional exposures should be risk assessed ensuring mitigation measures are included for threat to life; threat to property and threat to contamination of the product, the building, site services or the environment. This should consider the exposure of the refrigerant under pressure, when released and when exposed to external heat/fire.

One common refrigeration gas to keep in mind is ammonia. Ammonia is a toxic, contaminating and flammable gas and therefore poses multiple exposures to the chamber. For this type of policy the critical exposure is the contamination aspect of ammonia. There have been many instances where a release of ammonia has contaminated the storage chamber and the stored commodities have had to be scrapped.

Please see Aviva's Loss Prevention Standard on Ammonia Refrigeration Systems. This provides guidance on physical arrangements; ammonia detection and associated ventilation needs all of which will have an impact on the reduction of a leak and contamination.

Contamination

In relation to a Deterioration of Stock policy, contamination needs to consider a sudden and unforeseen failure to the equipment maintaining the chamber environment. Examples can include… Failure or mechanical damage of the refrigeration cycle and refrigerant gas release that escapes into the chamber. E.g. a fan catastrophically failing and damaging the refrigerant fluid pipe; impact of something being dropped; vehicle impact to the refrigeration network.

Power Supplies

Aside from the exposure caused by loss of the refrigeration cycle itself, the power supply to the refrigeration equipment is equally important. Loss of power equals loss of cooling, air flow or air conditioning.

Therefore the exposure caused by loss of power should be risk assessed.

Areas to consider should be:

- Resilience of the power supply and the power network and any associated interruptions.
- Uninterruptable power supplies (UPS) – installed and ready to operate immediately
- Emergency generators – installed and ready to operate immediately;
    - Automatically and manually starting
    - Synchronised
- Pre-installed readily accessible emergency generator connection points for leased in units to be plugged into;
    - With appropriate switching
- The wiring/cabling routing and its exposures
- For small chambers/refrigerators/freezers:
    - It should be wired into a switchless socket OR
    - An unswitched fused spur to avoid accidental loss of electrical supply.
    - In some cases, covering any socket and labelling it 'essential equipment do not switch off' should also be considered.

Where the business has back-up generators or an uninterruptable power supply (UPS) system, the risk assessment should consider the length of time this equipment can be operated without the primary power source. This needs to form part of the Business Contingency Plans e.g. operating time at full load; fuel supplies for generators etc.

Inspection, Testing & Maintenance

To help ensure the equipment and associated control systems perform as expected, do not breakdown or fail prematurely, formal and informal inspections; formal testing and maintenance regimes should all be in place. All formal activities should be recorded.

At a minimum, this should be based on the recommended frequencies as described by the equipment manufacturers, or any associated regulatory requirements. It should be very much aligned to the business risk posed by the loss of such provision.

The risk(s) posed by mechanical or electrical failure, where there is a controlled environment, should be fully understood and tasks prioritised accordingly.

- All equipment should be inspected, tested and maintained in accordance with the manufacturer's guidance.
- Any critical or key spares should be identified and an appropriate inventory maintained in an area away from the operating equipment (ideally a separate fire area).

All refrigeration cycle controls; refrigerant monitoring systems (including those for ammonia leakage); temperature monitoring and all control devices should be:

- Independently tested and calibrated at least annually to ensure temperature readings are accurate.

Based on the nature of the equipment and need to maintain the chamber environment, in house expertise may not always be readily available. Therefore where required, formal maintenance contracts with 'competent' engineers should be in place.

- At a minimum, the refrigeration equipment and associated chamber should be physically visited at least every six months by such skilled engineers to help ensure everything is maintained and is in good working order.

As part of regular self-inspections/audits, the individuals completing these tasks should pay particular attention to the equipment that is operating for any abnormalities. Examples could include:

- Elevated temperatures – motors running hot; evaporators; fans or bearings running hot etc. plant rooms appearing hotter than normal.
- Increased noise levels – motors, fans, bearings etc. or their casings making new noises or noises louder than previously heard.
- Increased vibration levels – pipes moving; brackets or fixings coming loose; joints starting to leak etc.

Note: This includes any fans and motors in the chamber itself.

The area housing the refrigeration equipment should be maintained totally free of combustible materials and sterile.

Of the storage chamber itself, visual inspections should be carried out regularly to look for damage including to the panels and joints/seals; door seals; closing mechanisms and for any leaking fluids.

Any ammonia detection, fire detection or fire suppression systems should be inspected, tested and maintained regularly and be function tested at least annually. This should include any associated interlocks.

If there are any drip trays or condensate drains on the equipment including in the chamber itself these should be:

- Non-combustible – there have been fires with plastic drip trays and down spouts
- Inspected regularly for foreign materials; blockages etc.

Where electric cables pass through metal panels, the cut intersection of the metal panel should be grommeted to help prevent damage to the cable insulation and expose 'live' elements of the cable.

Permit Systems

Because of the potential hazards expected with cold stores and the associated refrigeration equipment, any employee or third-party organisations completing maintenance activities in or around the cold chamber (or associated refrigeration equipment) should be undertaken under an appropriate 'Permit to Work' system. This should include having formal Risk Assessments and Method Statements for the proposed activities.

In addition, if other exposures exist the method of work may need to be further managed with other safety controls such as:

- Hot work permit system
    - Note: Hot work should be prohibited on any combustible insulation materials or panels.
- Pressure system or line break permit
- Confined space permit system
- Working at heights permit system
- Lock out tag out (LOTO) system etc.

Thermographic Imaging

Thermographic imaging is a very powerful tool in temperature-controlled environments. Thermographic cameras are relatively inexpensive and can be used on a day-to-day basis as well as part of regular planned and predictive maintenance activities. The results are instantaneous and allow for immediate intervention.

In many cases, Aviva recommends an annual thermographic survey for the electrical systems on any site. However, in addition to this formal once a year activity, an owned camera or regular engagement with a 3rd party can be used for:

- ✓ Assessing the air movement and distribution/temperature profile within the chamber and establishing stagnant 'warmer' areas.
- ✓ Establishing any insulation issues in the chamber or with the refrigeration cycle.
- ✓ Understanding the effectiveness of closed doorways and their performance.
- ✓ Understanding the impact of open doorways.
- ✓ Assessing the performance of fans, motors, evaporators and compressors on the refrigeration cycle.
- ✓ Reducing power usage and losses etc.

Employee Training

It is essential that all employees are provided with sufficient training and refresher training at all stages of their career to:

- Allow them to undertake their normal duties.
- Realise when housekeeping and combustible loading is not as it should be, including:
    - Prohibiting storage on and around any filters, fans, heat exchangers and vents – these should be kept clear and sterile.
    - Prohibiting storage on the roof of the chamber – this area should be maintained sterile.
- Understanding local chamber temperature displays and reinforce the procedures when these start to deviate from normally expected temperatures.
- Understand the risks and exposures of a temperature-controlled chamber.
    - Including appropriate storage conditions and arrangements in the chamber itself.
- Understand the exposures from the refrigerating equipment and refrigerant gas.
    - If ammonia is present what that may actually smell like and all the hazards associated with it.
- Identify fault or damage conditions in the chamber.
- Identify and dispose of any deteriorating goods where they can pose a health hazard.
- React appropriately in emergency conditions and follow emergency and recovery procedures.

All training should be formally recorded to create a training record for every employee.

Emergency Response Plan

As part of any incident or loss event, a formal emergency response plan should be in place. This should be based on the:

- ✓ Risk assessments completed.
- ✓ Telemetry, alarms and control systems, detection and protection systems in place and their expected responses.
- ✓ Length of time from fault or alarm condition and the chamber moving out of specification for the products stored.

This should be a formal document and have named officials and their responsibilities detailed. It should also have key threats to the business identified and what actions to be taken:

- Loss of refrigeration
- Loss of power
- Loss of containment
- Contamination

The plan itself should be a live document, reviewed periodically and tested regularly.

Business Continuity Plans

It is important for any business to have formal business continuity plans that are considered as live documents, that are reviewed periodically and that are tested at least annually.

Where temperature-controlled storage arrangements exist, this plan should consider contingencies when the environmental conditions in the chamber cannot be maintained. This should be based on Business Impact risk assessments and could include:

- ✓ In situ, inspected, tested and maintained back up refrigeration equipment e.g. N+1, N+2 arrangements.
- ✓ In situ, inspected, tested and maintained UPS's.
- ✓ In situ, inspected, tested and maintained emergency power generators.
- ✓ The provision of a connection point for the connecting of temporary hired in refrigeration plant.
- ✓ The provision of a connection point for the connecting of temporary hired in power generators.
- ✓ Relationships with other similar temperature-controlled establishments (in house sister locations or partners) or mobile facilities that can accommodate the stored commodities without them going out of specification.
- ✓ Transferring the stored commodities to the customer earlier than originally envisaged.

In all cases, the response time should be suitable for the type of goods being stored before they go out of specification.

In all cases when hired-in equipment is to be used as part of the contingency plans, consideration to the following should be given:

1. Ensuring the connection points are installed and tested prior to any failure event.
2. The location of the connection points in relation to the site, yard storage, vehicles movements etc. These locations should not create additional enhanced risks to the site.
3. Having relationships and contracts in place for the equipment needed in the emergency. These should be detailed.
4. Testing the arrangements in practice and ensuring they work as desired.

Checklist

A generic Deterioration of Stock Checklist is presented in Appendix 1 which can be tailored to your own organisation.

Specialist Partner Solutions

Aviva Risk Management Solutions can offer access to a wide range of risk management products and services at preferential rates via our network of Specialist Partners, including:

- Electrical inspections and thermographic imaging.
- Fire stopping and passive protection.
- Thermographic imaging and PAT testing.
- Business continuity.

For more information please visit:

Aviva Risk Management Solutions – Specialist Partners

Sources and Useful Links

- Institute of Refrigeration https://ior.org.uk/

Additional Information

For more guidance, please see our library of Loss Prevention Standards.
Relevant Loss Prevention Standards include:

- Ammonia Refrigeration Systems
- Business Continuity
- Business Continuity Plan - Testing & Maintenance
- Business Impact Analysis
- Contamination Following a Fire
- Electrical Installations - Inspection and Testing
- Emergency Response Teams
- Escape of Water
- Fire Compartmentation
- Hot Work
- Maintenance Regimes
- Managing Contractors
- Thermographic Surveys

To find out more, please visit Aviva Risk Management Solutions or speak to one of our advisors.

Email us at riskadvice@aviva.com or call 0345 366 6666*

*The cost of calls to 03 prefixed numbers are charged at national call rates (charges may vary dependent on your network provider) and are usually included in inclusive minute plans from landlines and mobiles. For our joint protection telephone calls may be recorded and/or monitored.

Appendix 1 – Deterioration of Stock Checklist

Location	
Date	
Completed by (name and signature)	

	Size of the Store & Commodities Stored	Y/N	Comments
1.	Is the size of the storage area(s) known? Confirm the following in each case: • Length • Width • Height		
2.	Are the commodities being stored fully understood and recorded? • Are the upper and lower ranges of the permitted storage conditions fully risk assessed and aligned with appropriate Quality Control measures? Including temperatures; humidity; air quality etc. as appropriate? • Are the parameters associated with a commodity when it goes out of specification known and formally documented? • Do these parameters form the foundation of the risk assessments completed to maintain the continued operation of the chamber within the tolerable limits? • Do these parameters drive the level of emergency response and escalation plans?.		
3.	Are stock levels maintained below the manufacturer guidelines for any given storage chamber?		

	Refrigeration Equipment	Y/N	Comments
4.	Are the arrangements and control of the refrigeration equipment fully risk assessed?		
5.	Is the room or area housing the refrigeration equipment: • Located directly onto the roof/ceiling of the chamber? • In its own and separate 1 hour rated fire compartment? • Appropriately ventilated? Maintained totally free from combustible materials and sterile?		
6.	Are any oil leaks cleared away immediately with non-combustible non-wicking materials and the source of the leak repaired?		
7.	What is the age of the refrigeration equipment?		
8.	Have any of the components or major equipment items been refurbished or replaced? • If so when and why? Is this recorded?		
9.	Are any incidents or failures reviewed to ensure there are not common causes and all lessons are learnt? Do any such incidents modify inspection, testing and maintenance activities?		
10.	Is the system designed: • To meet the maximum thermal load? ○ Even during a prolonged hot summer period? • With resilience and redundancy built into the system? With duty and back up equipment for critical items? e.g. N+1 or N+2.		
11.	If back up equipment is provided: • Is this located in a separate fire compartment? • Does it have a separate piping network? Is it fed from different electrical switches?		

12.	In the defrosting cycle:
	• Are ice crystals formed in this cycle?
	  ○ If yes what is the effect of these crystals on the operating equipment?
	• Are icicles forming and then breaking off?
	  ○ What could be the impact damage or can these be entrained into other areas of the equipment?
	• Is there increased corrosion or rust caused by the defrost cycle?		

13.	Does the equipment have a history of malfunction, breakdown or damage?		
14.	Is the refrigeration system including air distribution/recirculation in the chamber appropriately designed and arranged for the storage configurations and occupancy?		
15.	Is the refrigeration equipment monitored? Are the following monitored? • Equipment operating – on/off? • Refrigerant cycle pressure? • Refrigerant cycle inlet and outlet temperatures?		
16.	Are there appropriate interlocks (cause and effects) to key process parameter alarms? Where needed, do these shut down the ventilation into the chamber?		

	Refrigerant	Y/N	Comments
17.	Has the Material Safety Data Sheet of the refrigerant been reviewed? Are: • The process conditions of the refrigerant and refrigeration cycle understood? • The arrangements of the refrigeration equipment risk assessed? Does this consider the exposure of the refrigerant under pressure? • When released? • When exposed to external heat/fire?		
18.	Are all exposures understood and mitigated to be As Low As Reasonably Possible?		

19.	Has a risk assessment considered the release of the refrigerant? Aside from the associated loss of cooling and the associated exposure to the commodity stored from a rising temperature, the loss of containment of the refrigerant can pose other hazards. Have these exposures been considered? • Fire? • Explosion? • Asphyxiation? • Corrosion • Toxicity? • Contamination? • Damage to the environment?		
20.	Is the refrigerant ammonia? If ammonia leaks or is released have the following exposures been considered: • Fire and Explosion? • Contamination to the stored commodity within the chamber?		

	Temperature Variation	Y/N	Comments
21.	Is the control, alarm and interlock philosophy consistent with the acceptable quality parameters of the stored commodities?		
22.	Are the arrangements designed for prolonged periods of high or low ambient temperatures?		
23.	Is the storage configured in a way that prevents appropriate air movement and can create 'stagnant' pockets?		
24.	Are there any openings into the chamber that cannot be closed? This includes any damage to the chamber itself.		
25.	Understanding there will be a temperature gradient throughout the storage chamber, are the temperature monitoring devices located in the most appropriate position? • Are these away from the chilled air inlets or the air recirculation fans? • Are there multiple monitoring points at different levels and in different areas?		

26.	Have 'low' and 'high' temperature (and humidity if important) alerts and alarms at slight deviations to the normal been provided? • Have 'low low' and 'high high' alarms been provided for more critical deviations and as the chamber approaches the 'off specification' upper and lower limits?		
27.	Have integral thermometer(s) been fitted to provide an immediate visual temperature confirmation for employees present on the ground?		
28.	Are internal or integral thermometers maintained? • Are they inspected and assured that they are in good working order?		
29.	Are the chamber doors: • Automatically closing? • On a timer to automatically close? • Alarmed if not appropriately closed or latched? • Kept locked/secure when not in use by employees?		

	Chamber Monitoring	Y/N	Comments
30.	Are all control systems, alerts and alarms etc. that are deemed important to the operation of the chamber monitored? Do these arrangements provide alerts and raise alarms to individuals to be able to respond accordingly?		
31.	If there is no automatic temperature logging, in line with a normal *Policy Condition* applied to the policy, is the temperature within the chamber is manually checked and formally recorded at least once every 24 hours? Does the record log the: • Date? • Time? • Temperature? This *must be* completed at a frequency of *at least every 24 hours*.		
32.	Is automatic fire detection provided in all areas? Is this interlocked to shut down the ventilation into the chamber?		

	Power Supplies	Y/N	Comments
33.	Has the exposure caused by loss of power been risk assessed?		
34.	Has the resilience of the power supply and the power network been reviewed?		
35.	Does the site have any uninterruptable power supplies (UPS) installed and ready to operate immediately?		
36.	Does the site have any emergency generators installed and ready to operate immediately? • Automatically and manually starting? • Synchronised?		
37.	If the business has back-up generators or an uninterruptable power supply (UPS) system, does the risk assessment consider the length of time this equipment can be operated without the primary power source? Does this form part of the Business Contingency Plans? e.g. operating time at full load; fuel supplies for generators etc.		
38.	Are there any pre-installed readily accessible emergency generator connection points for leased units to be plugged into? • With appropriate switching?		
39.	Are the wiring and cabling routes reviewed to ensure there are not exposed to impact or fire?		
40.	For small chambers/refrigerators/freezers: • Is the unit wired into a switchless socket or an unswitched fused spur to avoid accidental loss of electrical supply?		
41.	Is the electrical supply to any cold chamber secured and marked as 'essential equipment'?		
42.	Where electric cables pass through metal panels, is the cut intersection of the metal panel grommeted to help prevent damage to the cable insulation and expose 'live' elements of the cable?		

	Inspection, Testing & Maintenance	Y/N	Comments
43.	Is the storage chamber and the areas around the storage chamber maintained clean and tidy? Are the aisles between any racks or storage piles maintained clean, sterile and free from storage?		
44.	Are all waste materials handled appropriately and removed from site in a timely manner?		
45.	Is all equipment inspected, tested and maintained in accordance with the manufacturers guidance?		
46.	Are any critical or key spares identified? Is an appropriate inventory maintained in an area away from the operating equipment (ideally a separate fire area)?		
47.	Are all refrigeration cycle controls; refrigerant monitoring systems (including those for ammonia leakage where needed); temperature monitoring and all control devices independently tested and calibrated at least annually to ensure temperature readings are accurate?		
48.	If trained and skilled areas of competency are not on site, are formal maintenance contracts with 'competent' engineers in place?		
49.	To help ensure everything is maintained in good working order, is the refrigeration equipment and associated chamber physically visited at least every six months by trained and skilled engineers?		
50.	As part of regular self-inspections/audits are the following included: • Elevated temperatures – motors running hot; evaporators; fans or bearings running hot etc. plant rooms appearing hotter than normal? • Increased noise levels – motors, fans, bearings etc. or their casings making new noises or noises louder than previously heard? • Increased vibration levels – pipes moving; brackets or fixings coming loose; joints starting to leak etc?		
51.	Is the area housing the refrigeration equipment maintained totally free of combustible materials and sterile?		

52.	Of the storage chamber itself, are visual inspections carried out regularly to look for damage to: • The panels themselves? • The panels and associated joints/seals? • The door seals? • The door closing mechanisms? • The fluid carrying systems including signs of any leaking fluids?		
53.	Are the following inspected, tested and maintained regularly and be function tested in accordance with the appropriate regulations and at the least annually: • Ammonia detection • Fire detection • Fire suppression systems • Any interlocks. If these are connected to a monitoring station, a building management system, a SMS alert system or similar, in all cases are these connections and alarm receipts verified and confirmed?		
54.	If there are any drip trays or condensate drains on the equipment including within the chamber itself are these non-combustible? Are these inspected regularly for foreign materials; blockages etc.?		
55.	Are emergency generators: • Run tested at least monthly? • Full load tested at least annually? • Inspected, tested and maintained in accordance with the manufacturer's guidelines?		

	Permit Systems	Y/N	Comments
56.	Are any maintenance activities in or around the cold chamber (or associated refrigeration equipment) completed by any own employees or third-party organisations, undertaken under an appropriate 'Permit to Work' management system? Does this include: • Formal Risk Assessments? AND • Method Statements? for the proposed activities.		
57.	In addition, to a permit to work does the site have formal management systems and associated permits in the following areas: • Hot work management? ○ Is hot work prohibited on any combustible insulation materials or panels? • Pressure system or line break? • Confined space? • Working at heights? • Lock out tag out (LOTO)?		

	Thermographic Imaging	Y/N	Comments
58.	Does the site have its own thermographic camera? If yes, is this used regularly on: • Electrical systems? • Mechanical systems? • Refrigeration cycle? • Fluid/refrigerant carrying pipework? • Air movement and distribution in the chamber? • Chamber walls and roof, panel joints etc.? • Chamber doors and seals?		
59.	Is an annual thermographic survey completed for the electrical systems on site?		

	Employee Training	Y/N	Comments
60.	Are all employees provided with sufficient training and refresher training at all stages of their career?		
61.	Does this include: • Their normal duties. • When housekeeping and combustible loading is not as it should be? • Understanding local chamber temperature displays? • Procedures when the temperature starts to deviate from normally expected temperatures? • The risks and exposures of a temperature controlled chamber? • Understanding the appropriate storage conditions and arrangements in the storage chamber? • The exposures from the refrigerating equipment and refrigerant gas? ○ Including if ammonia is present? • Identifying fault or damage conditions in the chamber? • Identifying and disposing of any deteriorating goods where they can pose a health hazard. • Emergency and recovery procedures?		
62.	Is all training formally recorded to create a training record for every employee?		

	Emergency Response Plan	Y/N	Comments
63.	Is there a formal emergency response and escalation plan in place? • Is the plan itself a live document? • Is it reviewed periodically and after any changes? • Is it tested at least annually?		
64.	Is this based on the: • Risk assessments completed? • Telemetry, alarms and control systems, detection and protection systems in place and their expected responses? • Length of time from fault or alarm condition and the chamber moving out of specification for the products stored?		
65.	Does this document have named officials and their responsibilities detailed?		

66.	Does this document the key threats to the business and what actions to be taken? Including but not limited to: • Loss of refrigeration? • Loss of power? • Loss of containment? • Contamination?		

	Contingency Plans	Y/N	Comments
67.	Does the site have formal business continuity plans that are: • Considered as live documents? • Reviewed periodically and after any changes? • Tested at least annually?		

68.	Additional comments:

Please Note

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LOSS PREVENTION STANDARDS